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ABSTRACT

The ability of 1-month-old infants to recognize their mothers visually was explored with the live faces of mother and stranger presented in three different poses: en face (full face), half-profile, and profile. Subjects were 16 infants with normal Apgar scores at birth who were volunteered by their parents after an initial contact in a maternity hospital. Strangers' faces were closely matched to mothers' hair color, hair length, and facial complexion. It was predicted that, in the en face condition, a visual preference for the mother's face would be found. In the half-profile condition, it was again predicted that the mother's face would be preferred. In the full profile condition, it was predicted that no preference would be evident. Findings revealed that the en face and half-profile poses resulted in significant visual preferences for the mother. No preference for mother was evident in the profile pose condition. Temporal stability of observed memory is discussed along with potential methodological artifacts. (Author/RH)

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The perception of faces in different poses by one-month-olds.

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Abstract

An experiment is described in which the ability of 1-month-old infants to recognize their mothers visually was explored with the live faces of mother and stranger presented in three different poses. The en face and half-profile poses resulted in significant visual preferences for the mother being demonstrated, but the profile pose did not. The temporal stability of the observed memory is discussed along with potential methodological artifacts.

Introduction

A great deal of research has focused on the ability of young human infants to discriminate between and to recognize human faces. Field, Cohen, Garcia and Greenberg (1984) have shown that maternal face recognition may well be possible within the first week-of-life, while Bushnell (1982) and Maurer and Salapatek (1976) have demonstrated that 1-month-olds are capable of differentiating between the face of a stranger and that of the mother. Melhuish (1976), however, has reported a failure to discriminate between real faces on the basis of form or feature with successful discrimination only occurring when the comparison faces differed strongly in contrast. Melhuish argued that a study would have to carefully control hair-face contrast to prevent spurious discrimination being made on this basis. In fact Bushnell reported careful matching of his subjects on hair/face brightness and colour so that contrast levels were very similar across faces and discrimination was still found. Whether this difference in experimental outcome could be put down to sample variation or to Bushnell's use of colour slides rather than real faces is not clear. It would normally be accepted that real faces are more valid stimuli and a replication of the Bushnell study with real rather than representational faces would be useful to clarify this difference in finding, particularly as Maurer and Salapatek's positive results were obtained with a very small sample.

Almost all the work on the development of face perception has concentrated on discrimination between and recognition of faces presented in the normal **en face** orientation and there has been very little consideration of the face presented in other poses such as profile (side-view) and half-profile. Yet to the adult and older child, a face remains a face despite variations in pose. Fagan (1976) has looked at the face discrimination capacity of 7-month-olds when presented with photographs of faces in different poses and found that his subjects were able to recognize a face seen in one pose (e.g., en face) as being the same face when it was viewed in a different pose (e.g., profile). In addition Fagan found that his subjects could respond to invariance in pose, recognizing the same pose despite a change in face. Cohen (1977) has also shown that 7-month-olds are capable of recognizing a face seen in one pose (en face) as the same face when viewed in another pose (three-quarters profile facing upwards) and in addition has shown that the 4- and 5-month-olds in his study could not do this, although they could discriminate between

examples of the various poses. The ability of younger infants to process information about pose has not yet been documented, nor has the ability of infants to deal with pose in highly familiar faces such as that of their mother. Without an observational study to confirm relative exposure to each pose, it is possible only to make statements based on general subjective impressions, but the en face position will probably be the most commonly encountered pose when the young infant is awake and alert and the mother's face is sufficiently close to be clearly perceived. The next most common position will be one involving a slight rotational deviation around the vertical axis from the en face position and as the extent of this angular deviation increases so the familiarity of the face will decrease, until the face is turned 180° and is therefore facing away from the infant.

The process of learning the face of a particular other, for example the mother, will be greatly facilitated when the face is predominantly viewed en face and there is little variation from this pose. Of course the face of the mother in normal interaction with the baby will never be as static as a photographic representation and there will be continual internal featural modulation as well as rotational movement at varying rates and in several different planes. Therefore any ability to recognize a particular face must be the result of a process of detecting some level of invariance across time and presentations. Whether this capacity is sufficiently developed in young infants to ensure the conceptual equivalence of a particular face across fairly different poses is not clear, but it is certain that by 7-months-of-age the infant has learned that a face in one pose is the same as that face in at least some other poses and the ability to extract invariant information across different orientations has been shown to have been achieved (Cohen, 1977; Fagan, 1976). How then does this occur and what is the time-course of such a development?

An experiment is described which addresses part of this question area, exploring whether 1-month-old infants have the capacity to show recognition of their mother's face when presented in one of three orientations - en face, half-profile and profile.

Method

In one condition of this experiment, a group of subjects was presented with the face of their mother and the face of a female stranger of comparable hair colour and complexion, both appearing in the en face pose. On the basis of the previous study by Bushnell (1982) it was predicted that a visual preference for the mother's face would be found. It was further anticipated that the preference in this direction would be based on infants having consistently associated pleasurable experiences with the presence of their mother's face (Blass, Ganchrow and Steiner, 1984). In a second condition, the same subjects were presented with the face of their mother and that of a female stranger, both in a half-profile pose. It was predicted that this face pose would be sufficiently familiar for it to have already been learned either as a variant of the en face pose or as a face in its own right which would thus permit the infants to make adequate discriminations and to demonstrate a preference for the mother's face. Finally a third condition involved the presentation of the face of their mother and that of a female stranger, both appearing in a profile pose. It was hypothesised that the relative unfamiliarity of this presentation to the infant would mean that there was no generalization of the characteristics of the mother's face to this pose, nor would an independent representation have been formed so that no preference would be evident.

Subjects

These were 16 infants (8 male and 8 female) volunteered by their parents after an initial contact in the maternity hospital. The mean age of the infants was 36.6 days (range 28 - 45 days), their mean birthweight was 3.41 Kg (range 3.00 - 4.18 Kg) and they all had normal Apgar scores at birth.

Stimuli

The faces that the infants viewed were the real faces of their own mother and of an adult female matched subjectively by the experimenters as closely as possible for hair colour, hair length and facial complexion. A different stranger's face was used for each subject, but the same face was employed for each subject across conditions. In the en face pose the stimulus faces were looking directly at the infant, whereas in the other two poses, the stimulus faces were looking directly ahead of them and therefore were not looking at

the infant. In the half-profile pose, the faces were turned away from the en face pose by 45° towards the centre of the screen. Since there were two trials, with each face shown once to each side of centre, each face was seen both in left and right half-profiles. In the profile pose, the faces were presented turned away from the en face pose by 90° towards the centre of the screen. Since there were two trials, with each face shown once to each side of centre, each face was seen both in left and right profiles.

Procedure

Subjects were brought by taxi to the developmental laboratory at a time of day which the mother believed to be a good time for spontaneous alert activity on the part of her baby. When subjects were judged to be in a quiet, alert state, they were brought from the waiting area to an adjacent room where they were held by an experimenter who attempted to maintain this optimal state. The mother and a volunteer female stranger, obtained from a large available pool in the adjacent university library, were asked to sit behind a white screen (2.5 x 2 m) into which at head height were cut two apertures (25 x 30 cm), one to either side of midline and separated by 12 cm. This allowed a good view of the hair and face of the stimulus faces from the infant's position, with lighting being provided by two fluorescent tubes above and in front of the faces. In order to prevent any effect on the data due to differences in the clothing of the stimulus figures, they each had a white sheet draped around their necks. The visible background was the same for both faces. In addition, a control for extraneous olfactory cues was utilised in the form of a strong air freshener, coated onto the screen surround immediately prior to each of the test trials. The white-coated observer stood centrally behind the faces, viewing the faces through an aperture and recorded fixations on a pair of buttons connected to a microcomputer.

There were two trials for each subject and each trial commenced once both stimulus figures had been satisfactorily instructed to adopt a neutral expression, to look directly at the infant's eyes in the en face pose or to look directly ahead in the half-profile and profile poses. They were asked not to move or make a sound during the brief test period. An experimenter monitored the stimulus faces to ensure that no deviation from the neutral expression occurred during testing. The infant was then introduced to the stimuli by being brought upright into a seated position at a point 30 cm from

the central point between the two faces, the baby's head being supported but free to move in a lateral arc. The first trial commenced with the infant's fixation of either face and terminated after 20 sec fixation had been accumulated to either or both faces. Fixations were judged by the central observer and recorded on the microcomputer which gave an audible signal to indicate the trial ending. After the first trial, the infant was withdrawn from the apparatus and the two stimulus figures changed seats to counteract the influence of side bias. The procedure was then repeated for the second trial until a further 20 sec fixation had been accumulated.

The order of conditions was randomized across subjects and the infants were given at least a 10-minute break between testing sessions and frequently much longer. Half of the subjects, 4 male and 4 female, were tested by one experimenter and the other half were tested by another naive experimenter. Videotapes of 4 test sessions from each observer were scored by a separate experimenter, the obtained correlation being $r=0.89$.

Results

The amount of fixation to the mother's face was examined in a three-way ANOVA with the within subjects factor Pose (en face, half-profile, profile) and the between subjects factors Observer (O1, O2) and Sex (Male and Female). The only effect to reach significance was that attributable to Pose ($F=9.72$, $df=2,24$, $p<0.002$), with significantly more fixation to the mother being found in both the en face ($t=5.78$, $df=30$, $p<0.005$, one-tailed) and half-profile ($t=4.93$, $df=30$, $p<0.005$, one-tailed) poses than in the profile pose. The differences in fixation to mother and stranger are shown in Fig. 1 and these were examined further using correlated t-tests which confirmed that infants fixated their own mother's face more in the en face pose ($t=4.29$, $df=15$, $p<0.001$, one-tailed) and in the half-profile pose ($t=3.99$, $df=15$, $p<0.002$, one-tailed), but no preference was found in the profile pose ($t=-.53$, $df=15$, ns, one-tailed).

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Fig. 1

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In order to determine whether another variable would be sensitive to the apparent differences between conditions, a further 3-way ANOVA was computed using the number of changes in fixation between the two stimulus faces over the two test trials. The between subjects and within subjects factors were as before. No main effects or interactions were found to approach significance.

Finally, the age of the subjects was correlated with the amount of fixation to the mother in the three conditions. The three correlations were positive, (en face - $\underline{r}$=0.25, ns; half-profile - $\underline{r}$=0.54, $\underline{p}$<0.03; profile - $\underline{r}$=0.28, ns), but only the half-profile correlation attained significance.

Discussion

The results of this experiment confirm the previous findings of Bushnell (1982) and Maurer and Salapatek (1976) that 1-month-old infants are capable of discriminating between the face of their mother presented en face and that of an adult female stranger in the same pose. The results also support the conclusion that 1-month-olds have the ability to discriminate between two faces in half-profile and to recognize their mother's face in these two poses. In addition, these results are demonstrated to hold even when an attempt was made to match the hair colour and face brightness of the stimuli across comparison faces and when a control for olfactory cues was utilised. It is suggested that the problems encountered by Melhuish in attempting to demonstrate face discrimination may be attributable to characteristics specific to his stimuli, to his use of a single successive stimulus presentation rather than paired comparisons and possibly his use of too many different comparison stimuli (Greenberg and Blue, 1977).

The analysis of these data also indicates that there is no evidence of face discrimination when the profile pose is used and while this cannot logically be taken to imply that profile discrimination is impossible, it certainly suggests that 1-month-olds in this situation are providing no indication of an ability to discriminate between two similar faces on the basis of recognition of their mother's face when viewed in profile. Since it is likely that infants have much less familiarity with the profile pose than with the other poses, it is perhaps not surprising that only the profile pose failed to indicate recognition

memory through a significant preference for the mother's face. This question of familiarity through experience is perhaps supported by the correlations between pose and age. The only significant correlation was that for the half-profile pose and this may have been because it was being strongly established at this time while the en face pose was already well known by even the youngest of subjects and the profile pose was yet to be learned.

No main effect was found for sex, nor indeed was there any interaction. While no sex effects had in fact been predicted, it was though useful to include this variable because of the possibly greater face-to-face contact experienced by female infants given the reported finding that they receive more vocalizations from their mother (Moss, 1967).

An important point which has been raised by a number of commentators on this type of research is that while the mother may have been specifically instructed to do nothing to attract her infant's attention, she may be sufficiently motivated to ignore these instructions either deliberately or not. While an experimenter who was monitoring facial expression and vocalization did not notice any systematic maternal "encouraging" of fixation, this possibility cannot be discounted. However, a recent study with newborn infants has demonstrated that this is not a likely explanation for the discrimination found. Bushnell and Sai (1987) filmed a sample of mother and stranger pairs while infants were being tested for face discrimination. These tapes were viewed by adult observers who failed to reliably identify the mothers on the basis of their behaviour during testing. The neonates, however, did show evidence of recognizing their mothers.

The olfactory control's effectiveness cannot be definitively assessed from this study, although the failure to find a mother-preference in the profile experiment does support the elimination of olfactory cues which would otherwise have allowed an attentional preference to have been displayed. On the other hand it is possible that an attentional preference based on olfaction is outwith the capabilities of 1-month-olds and that the control is therefore unnecessary, at least under present conditions. However, there is good evidence in favour of young infants demonstrating olfactory preferences for the mother (Cernoch and Porter, 1985; MacFarlane, 1975) and the control may constitute a useful addition to this type of experimental procedure.

Another aspect of the ability to recognize the mother's face which is of interest is the temporal stability of this memory. Under the present test conditions (and probably those of most previous research) subjects had access to their mothers, through at least one of their senses, immediately prior to the start of the experimental session. The delay between infants being removed from the mother and then being exposed to her as a stimulus object was as short as 3 minutes on some test sessions, although somewhat longer on others. It is possible therefore that the exposure to the mother's face prior to testing constituted an informal habituation period which was then followed by a delayed recognition test. One major problem with this thesis is that a novelty preference is normally expected after habituation and the opposite was found. This result could have been due to the "habituation period" being insufficiently long to achieve habituation and thus what was exhibited was the commonly reported familiarity preference after incomplete habituation. However, this is unlikely because the preliminary exposure to the mother prior to testing was certainly more than 3-minutes and there is existing evidence that habituation to the human face does not normally take much longer than this even in newborns (Field, Cohen, Garcia and Greenberg, 1984). Other possibilities are that continued presentation of a stimulus for considerably longer than is required to permit habituation (as normally defined) may lead to the establishment of a familiarity preference and/or that delayed testing of recognition memory may promote the demonstration of a familiarity preference. There is some evidence which can be brought to bear on these suggestions and which tends to refute both. Bushnell. McCutcheon, Sinclair and Tweedlie (1984) reported a study in which 2-week-olds were familiarized to a geometric stimulus for 30 minutes per day over a two-week period. At 4-weeks-of-age, after delayed recognition testing, a significant novelty preference was found. It therefore seems that the preference for the mother that was found in two of the present experiments was a result of the mother's face (or faces) being represented as a permanent memory entry that had already become associated with positive reinforcing experiences and had developed strong perceptual salience. This memory may be quite stable over lengthy time periods and is unlikely to be a short-term habituation effect.

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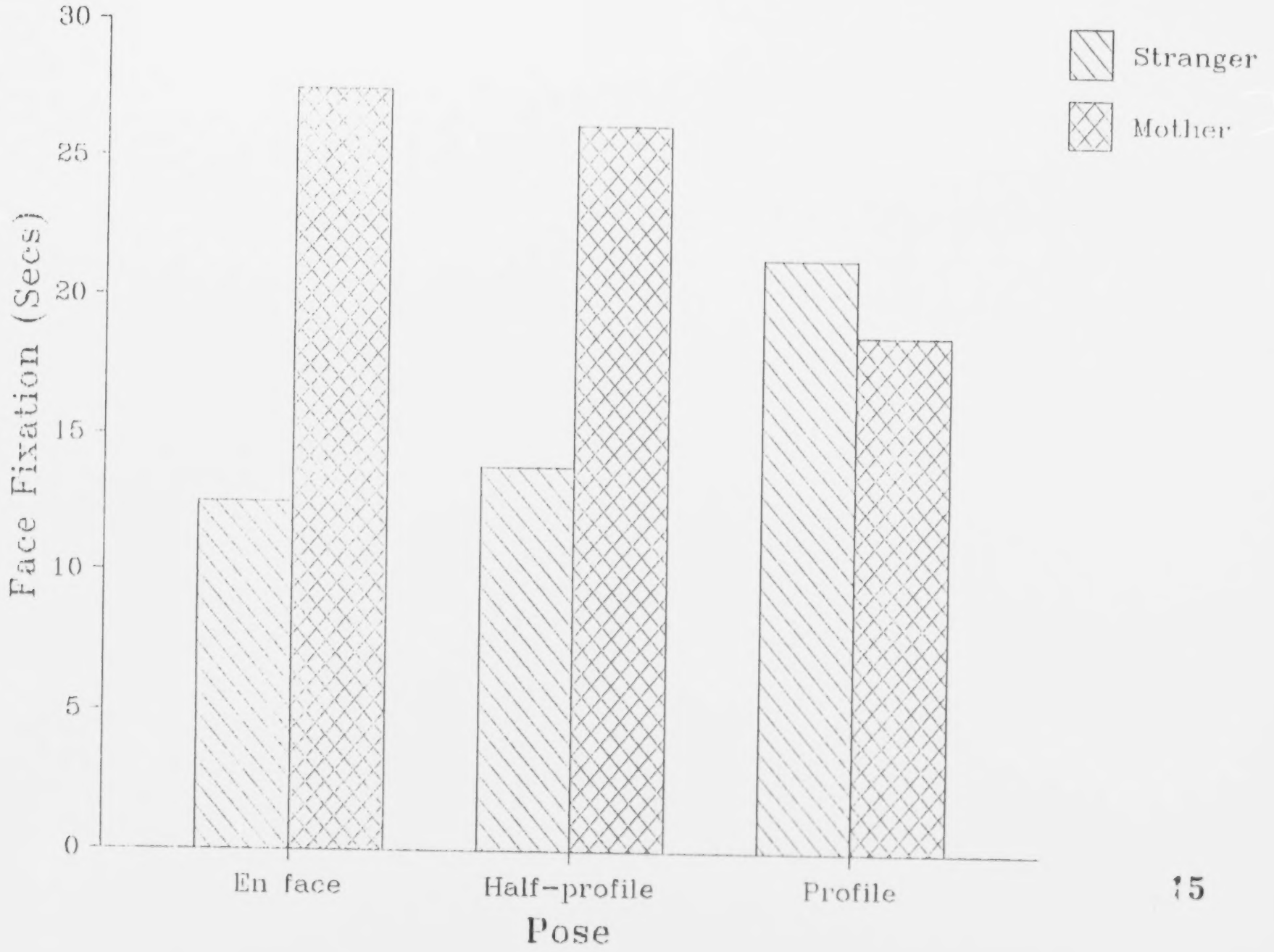
Figure Legends

Fig. 1. Relative fixation to mother and stranger in the three pose conditions.


30
25
20
15
10
5
0
Face Fixation (Secs)
Stranger
Mother
En face
Half-profile
Profile
Pose